



# **TECHNOLOGY: shifts in the foundational paradigms of Big Data to create next generation capabilities**

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# Shifts in Paradigms for Data Analysis

- Dynamic and adaptive design of data analysis methods based on data characteristics
- Heuristics in statistics
  - AI paradigms applied in computational processing
- Systems that “reason”: analyzing data in context of existing knowledge
  - Information extraction and understanding of text
  - Semantic analysis and encoding of published works
- Model synthesis from first principles, hypotheses and data analysis/mining



# Shifts in Paradigms for Data Analysis - 2

- Model guided data collection



Data guided model revision

- Collaborative synthesis of new knowledge
  - “Human Computation” applied to model formation and discovery
- *Discovery Informatics*
  - Automating methods for understanding causality and casual cascades
  - Representing and capturing scientific process (e.g., scientist activities)
  - Building more effective many-human-computer team interaction



# Big Data Capabilities

	Small Era	Big Era	Next Generation
<b>Goals</b>	Answer a specific question, establish correlations	Flexible goals, possibly ill-posed questions, probabilistic prediction	Knowledge assimilation and reasoning, understanding causality
<b>Location</b>	One place	Highly distributed	Amorphous
<b>Data Structure &amp; Content</b>	Highly structured	Absorbs unstructured data from many sources	Differing in uncertainty and quality; combined with certified knowledge
<b>Data preparation</b>	By user or small group	Many sources, many people, possibly unconnected to users	Captured raw, ad hoc; combined w/ certified, standardized data
<b>Longevity</b>	Limited	Perpetual	Perpetual and reuseable
<b>Reproducibility</b>	Repeatable	Not necessarily repeatable	New data, information, knowledge continuously alters results
<b>Analysis</b>	All data analyzed together, all at once	Analyzed in incremental steps, distributed	Continuous processing within context

Adapted from Berman, J.K.(2013) *Principles of Big Data*, New York; Elsevier



# Still in progress ...

- Foundational shifts supporting:
  - real-time processing of continuous data / continuous analysis
  - customized hardware and networking architectures for infrastructure
- Sensing → Data → Knowledge → **Practice**



**Thanks!**

